Yukon 21

Skookum Jim Friendship Centre Retrofit Training

CREDA is a program which has been jointly funded by Energy, Mines and Resources, Canada and the Yukon Government, Department of Economic Development and Tourism. For more information or copies of reports contact the Energy and Mines Branch, Yukon Government, Box 2703, Whitehorse, Y1A 2C6.

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

This project report is prepared by Arctech for the Government of Yukon, Energy and Mines Branch. The project included the delivery of an energy conserving retrofit training program, developed specifically for northern carpenters. This nine month program was delivered by Arctech, a northern energy management firm based in Whitehorse.

In addition to this report, a video program on the retrofit training project was produced by Arctech for the Government of Yukon, Energy and Mines Branch. Copies of this video are available upon request.

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Appendix A: Retrofit Training Curriculum Outline

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Foreword

The availability of secure and affordable energy supplies is a subject of national concern. Our primary energy sources are becoming more costly and less accessible. However, Canada has both the resources and the technical expertise necessary to develop renewable and alternative sources of energy.

The governments of Yukon and Canada have entered into a Conservation and Renewable Energy Agreement (CREDA) as one means of pursuing this end. Cost-shared by the territorial and federal governments, CREDA has a budget of $3.3 million, and is dedicated to the development and demonstration of conservation and renewable energy technologies.

The objectives of CREDA are:

* to develop and demonstrate promising new technologies, which, when widely adopted, will exploit renewable resources, conserve energy, and/or use energy more efficiently.

* to develop broad public awareness of the potential of renewable energy and conservation technology

* to provide opportunities for the commercial application of the technologies

* to create economic spin-off benefits for manufacturing, industry, and commerce

* to create employment in new or existing energy-related industries

The project described in the following report is intended for use by the northern housing industry. The information included in this manual will provide housing administrators and building contractors in the North with a guide to energy conserving retrofit theory and proven construction techniques, which may be applicable to retrofit or new construction projects.

Special emphasis is placed upon techniques which are appropriate for remote villages and cold northern climates. These techniques are designed to use locally available materials and labour wherever possible.

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Executive Summary

Houses in northern ©communities generally have lower comfort levels and shorter useful life-expectancies than dwellings of similar construction in milder climates. Many of these buildings can be retrofitted to current energy standards at substantially less cost than replacement of an entire building.

Proscriptive standards which have governed the construction industry are currently undergoing major review and upgrading. Many of these standards are being altered for the north in recognition of the effects of long cold winters on building structures and materials.

The research and testing of retrofit materials and techniques has taken on an important role in the development of building science in the Yukon. Such techniques, and the expertise required to implement them, have been frequently unavailable in the north.

Many operating and maintenance problems associated with northern buildings are a result of inadequate understanding of energy related factors. The frequent evidence of building materials degradation indicates the need for upgrading the skills of existing construction trades in the north.

To meet this need, a training program for carpenters was developed to address specialized retrofit and observational skills, and to develop expertise in recognizing and solving energy related problems with buildings.

The construction techniques and training methods described in this report were developed and refined during a nine month Energy Conserving Construction Training Program under the management of the Skookum Jim Friendship Centre in Whitehorse, Yukon.

The Skookum Jim Retrofit Training Project has been a significant success, both in terms of northern training programs, and cost-effective northern retrofit construction.

Rénovation et ré-isolation du centre Skookum Jim

Résumé pour l'exécutif

Les maisons que l'on trouve dans les communautés nordiques offrent en général un niveau de confort moindre et ont une durée d'utilisation plus courte que les maisons de construction semblable dans des climats tempérés. Il est possible de ré-isoler et de rénover un grand nombre de ces immeubles selon les normes énergétiques actuelles pour un coût bien moindre que le coût de remplacement d'un immeuble en entier.

On s'emploie présentement à réviser de fond en comble et à moderniser les normes à caractère prohibitif qui ont gouverné jusqu'à présent l'industrie de la construction. Bon nombre de ces normes sont en train d'être modifiées en fonction du climat nordique, car on reconnait maintenant les effets que les hivers longs et rigoureux ont sur les structures et les matériaux de construction.

Les travaux de recherche et de mise à l'épreuve des techniques et des matériaux de rénovation et de ré-isolation occupent une place importante dans le développement de la technologie de la construction au Yukon. Ces techniques, et la compétence nécessaire pour les appliquer, ont été fréquemment indisponibles dans le nord.

Bon nombre des problèmes d'entretien et d'opération associés aux immeubles construits dans le nord sont le résultat d'une compréhension inadéquate des facteurs énergétiques. Le fait qu'on puisse fréquemment observer la détéroriation des matériaux de construction prouve qu'il est nécessaire de moderniser les techniques actuelles des métiers de la construction dans le nord.

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Afin de pourvoir à ce besoin, on a instauré à l'intention des charpentiers un programme de formation visant à leur enseigner les techniques spécialisées de la rénovation et de la ré-isolation. Ce programme a aussi pour but de créer la compétence voulue pour identifier et résoudre les problèmes énergétiques rencontrés dans les immeubles construits dans le nord.

Le projet de rénovation et de ré-isolation du centre Skookum Jim à Whitehorse a fourni une opportunité idéale de former dix charpentiers et d'en faire des spécialistes en matière de construction à haut rendement énergétique au niveau des communautés à travers le Yukon. Le terme "rénovation et ré-isolation" désigne le procédé par lequel on incorpore à la construction les technologies nouvelles et améliorées dans le but de moderniser un immeuble et d'en améliorer le rendement énergétique.

Les techniques décrites dans ce manuel ont été développées et étudiées durant les neufs mois qu'ont duré ce programme de formation des métiers de la construction, à haut rendement énergétique, programme couronné de succès qui a été supervisé par le centre Skookum Jim à Whitehorse au Yukon.

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

1.0 Introduction

The retrofit/renovation of the Skookum Jim Friendship Centre in Whitehorse, Yukon, provided an ideal opportunity to train ten carpenters as specialists in energy conserving construction at the community level throughout the Yukon.

The term "retrofit/renovation" refers to the process of incorporating new and better technologies for the purpose of upgrading or improvement of a building.

Through this project, the trainees have gained special skills through hands-on experience with many energy conserving materials and techniques. As well, the training sessions provided extensive information on applicable thermodynamic principles and building science technology.

The crew of two instructors, ten trainees, and the foreman covered all aspects of residential/light commercial construction which apply to retrofit work. Training sessions included information on site-safety, and interpreting the National Building Code, as well as special attention to the air tightness and insulation levels in the building.

The retrofit for the Skookum Jim Centre was designed to incorporate many energy conserving construction techniques which will work successfully on northern buildings.

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

2.0 Background

The Skookum Jim Friendship Centre is known locally as "Skookies". It is one of eighty three friendship centres across Canada, which are involved in cross-cultural education and social programs and activities.

The Centre was built in 1961 utilizing a trust fund established by James Mason. Mason was known to many as "Skookum Jim", one of the co-finders of the Discovery gold claim on Bonanza Creek. This event triggered the famous Klondike Gold Rush.

By 1983, the implementation of educational and recreational programs undertaken by the Centre were being constrained by the size and layout of the building. In addition, there were other problems with the building which were limiting the level of service which the Centre could provide to the community.

Frequent plumbing freeze-ups and high heating bills during the previous winters provided the incentive to undertake a complete energy conserving retrofit as well as major renovations.

The building committee of the Skookum Jim Friendship Centre worked with a local architect, and Arctech, a local energy management firm, to design the retrofit/renovation for the new building.

The retrofit/renovation design for the Skookum Jim building follows the form of the traditional longhouse of the native people, with long main walls and short end walls. To increase the interior space of the building, the renovation design included the addition of a new second floor, and two entry and staircase vestibules.

3.0 Northern Retrofit Planning

In the cold northern climate, human comfort is costly to maintain in thermally inefficient buildings. In addition to comfort and cost factors, northern buildings themselves are subject to more rigorous temperature extremes during the year than buildings farther south. Signs and symptoms of degradation inevitably show up sooner on northern buildings due to the extended cold winters.

Many buildings in the north do not use energy efficiently, because they are not adequately insulated or protected from cold drafts and hot air leaks. Most of these buildings can be upgraded to provide greater comfort to the occupants at significantly reduced energy costs. With planning, energy conserving retrofit can play a major role in extending the useful life of many buildings in the north.

The retrofit planning process involves two components which influence human comfort: building design and climate. The two specific objectives in retrofit planning are to reduce the heating requirements of the building by designing for the climate, and to maintain (or improve) the comfort levels of the occupants.

3.1 Design Factors

In a harsh climate, design is a major factor in determining the energy demands of a building. In the case of retrofit, the process is one of re-evaluating the original building design. The major factors to consider in this evaluation are; building orientation and siting, form and function, and operation and maintenance.

3.1.1 Building Orientation and Siting

The ideal energy conserving building is oriented to use the heat energy available from the sun (solar availability). In the Northern Hemisphere, the building should be redesigned with most of the windows facing south and east to maximize solar availability. The building site is also important, as landform and contour can play an important role in protecting the building from the harsh effects of winter winds. Where possible doors should be moved away from walls where winter wind penetration will present a problem.

3.1.2 Form and Function

Since heat loss occurs through the surfaces of the building shell or "envelope", the shape of the building (called building "form"), and the thermal resistance of the materials used, are of great importance in the North, where the heating season lasts for at least nine months of the year.

When developing the design for a building, it is important to consider the area of surface which is exposed to the weather, and the thickness of insulation incorporated into the walls and the ceiling.

The relationship between surface area and interior space is called a "surface area to volume" ratio. A cube has a small (and therefore "energy efficient") surface area to volume ratio. However, a cubic building does not always meet the needs of the building occupants. The basic cube shape is usually modified to a more suitable design, while still maintaining a low surface area to volume ratio.

The function of a building plays a major role in building design. Occupancy factors, traffic flow, storage requirements, and the nature of activities taking place in the building are all factors which help to determine the most suitable design for the building.

Since most buildings can benefit from additional space, it is often cost effective to include an addition as a part of a retrofit renovation. One design option which may be used in conjunction with an energy conserving retrofit is the addition of a second story. This option provides additional space without the cost of additional foundations, as well, components of the existing roof can often be salvaged.

Another design option is to add a porch or "vestibule" area to the existing structure. Vestibules can be effectively used for storage and stairwells, to provide more useable space in the main area of the building. Vestibules also provide a buffer zone during the winter to keep out cold drafts. They conserve energy by isolating the area around the door to the outside, thus reducing the volume of cold air moving into the rest of the building when the door to the outside is opened or closed.

3.1.3 Operation and Maintenance

Retrofit technology considers two aspects of energy use: energy demand and energy supply. These two concepts are the basis for designing, evaluating, and analyzing energy use options.

Energy demand can be reduced by designing a thermally efficient building envelope to reduce the energy lost through the building surface.

Energy supply includes the heating and air-handling systems to maintain comfortable levels of temperature and humidity for the occupants. Building design includes the specification of these heating and air-handling systems. Once the structural details of the design have been determined, these operating systems are matched to the heating and ventilation requirements of the building.

Heating system options include oil-fired, gas-fired, and wood fired appliances, and electric heating.

Depending upon the function of the building and the needs of the occupants, air-handling systems can be as simple as a "Yukon vent", or as complex as an air-to-air heat exchanger which recycles exhaust air heat.

3.2 Climate Factors

Heat loss or "energy demand" of buildings is influenced by air leakage and the thermal resistance of the building envelope. In the north, the temperature differential between the interior and exterior of a building is high for much of the year. This causes greater stress on building components, and can lead to premature degradation through moisture damage and dry rot.

Inadequate air-sealing and insulation levels tend to become visible in the form of building maintenance problems and structural degradation. In northern buildings, these visible signs of energy loss tend to be more dramatic than they are in the south. Because the climate intensifies the effects of weather on buildings, the long northern winter plays a major role in determining the levels of insulation and air-tightness of a building. These factors must also be considered at the planning stage.

3.2.1 Air-Vapour Barrier

One challenge in Northern retrofit construction is to prevent the occurance of condensation inside the wall. As warm air cools, it loses its ability to hold moisture. This moisture is released as condensation when the air cools to the dew point.

If condensation occurs in the walls and ceilings of a building, the moisture soaks into the insulation, and fills up the tiny pockets of air, which significantly reduces the insulating value. Condensation can also penetrate the wooden framing members, creating the environment for "dry rot", which can lead to structural failure.

The purpose of the air-vapour (a-v) barrier is to prevent the migration of warm, moist air from the inside of the building to the outside. In most northern buildings as much as one half of the heating cost goes to heat cold air which leaks in to replace warm air which leaks out. An a-v barrier control this warm air leakage and cold air drafts. As well, the a-v barrier prevents the water vapour inside the building from reaching the point in the wall where it is cold enough to condense as moisture inside the walls. Polyethylene sheeting is an effective a-v barrier if it is properly placed and sealed.

In cold northern climates, research has shown that an effective a-v barrier must be placed such that there is at least twice the R value of insulation on the cold side of the a-v barrier as there is inside the a-v barrier.

This "one third:two thirds" rule of thumb can be achieved in an exterior wrap retrofit situation by placing the a-v barrier around the outside of the building shell, and then installing additional insulation with at least twice the R-value of the existing insulation on the outside of the a-v barrier.

For example, if a building with R-12 fibreglass in the walls is wrapped and sealed with polyethylene, then a minimum R-24 must be added on the outside of the polyethylene.

Ten mil polyethylene is a durable a-v barrier material of suitable strength for most retrofit projects. The additional cost of this heavier material pays back in easy handling. As well, the heavier polyethylene is respected as a construction material, rather than being treated as "sandwich wrap". Large sheets of poly are used wherever possible to minimize seams. For extra protection, all seams in the a-v barrier are overlapped and sealed with a double bead of acoustical sealant, and secured to solid backing.

3.2.2 Above Grade Insulation

Thermal resistance, known as the "R-value" (or Rsi in metric), measures the amount of resistance to the flow of energy or heat through a specific material. Insulating value is measured as the amount of thermal resistance per thickness of the material being tested.

Due to the insulating value of the tiny pockets of trapped air, materials such as fibreglass, styrofoam, or cellulose have a higher resistance to the flow of energy than wood. Wood has a higher thermal resistance than dense solids, such as glass, metal, or concrete.

Although there are several types of insulation materials used for different applications, the selection of insulation is often determined by economic factors as well as the insulating qualities of the material.

In most cases the rigid board insulations are three to four times the cost of the batt or loose fill insulations when compared on a "dollar per square foot per R-value" basis.

3.2.3 Below Grade Insulation

Basement insulation is very important, because bare concrete foundation walls account for a great percentage of heat loss from any building. Concrete is an extremely poor insulator, and any insulation will significantly reduce heat loss.

There are two basic methods for increasing basement insulation in existing buildings: exterior and interior applications. Exterior applications are preferred since heat loss is more effectively blocked, and the thermal mass of the insulated concrete reduces temperature variation in the building. Styrofoam or polystyrene board, or rigid fibreglass insulation is usually used for exterior applications, while fibreglass batt is most commonly used for interior retrofit.

Extruded polystyrene (blueboard) is the best choice for below grade exterior applications, because it will not soak up moisture. Rigid fibreglass and beadboard are nearly as expensive as polystyrene, however, both of these materials will absorb moisture.

In an exterior basement retrofit, the earth is excavated around the building to the desired depth, and enough width to permit access to the foundation wall. The a-v barrier from the wall above should be long enough that it is well overlapped by the styrofoam. Rigid styrofoam boards can then be positioned, and backfilled immediately to avoid slippage.

4.0 Skookum Jim Building Retrofit Plan

The Skookies building is located on a flat river gravel base in downtown Whitehorse. The building is oriented on a north-south axis, with the front of the building facing west. The existing foundation orientation and architectural constraints limited the integration of passive solar design.

In the design for the Skookies building, one objective was to achieve the greatest amount of interior space, while minimizing the amount of building surface exposed to the weather.

The interior design for the building included a large central reception area, increased office and meeting space, a full kitchen and dining and recreational area. An entire second storey was added to accommodate three classrooms and study areas. The retrofit for the exterior of the building incorporated the principles of low surface area to volume ratio.

A "curtain wall" design, developed by Arctech, was used to retrofit the main floor walls. The curtain wall design has many suitable applications for the North. The second storey featured a "double stud wall" design, which has been used in many new energy conserving construction projects. Both the curtain wall and the double-stud wall significantly increase the thickness of the wall cavity to provide room for additional insulation. The Skookies renovation included two balloon-framed vestibules, one on either end of the existing structure. These construction techniques are described in greater detail in following sections of this report.

Ten mil polyethylene was used as the a-v barrier throughout the Skookum Jim building. Large sheets of poly were joined with a double bead of acoustical sealant. Staples, when used to secure folds and overlaps at corner seams, were applied through the acoustical sealant to hold the poly. Otherwise, a square of duct tape was used wherever staples penetrate the poly.

Polyethylene was wrapped around the exterior of the original main walls and basement. Prior to the construction of the vestibule walls, a strip of poly was attached to the main wall to provide continuity between the a-v barrier of the basement and main floor walls and the a-v barrier in the vestibules. In the vestibules, the poly runs around the inside of the walls and roof. The a-v barrier runs between the two walls of the second storey, and is sealed to the vestibule a-v barrier.

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

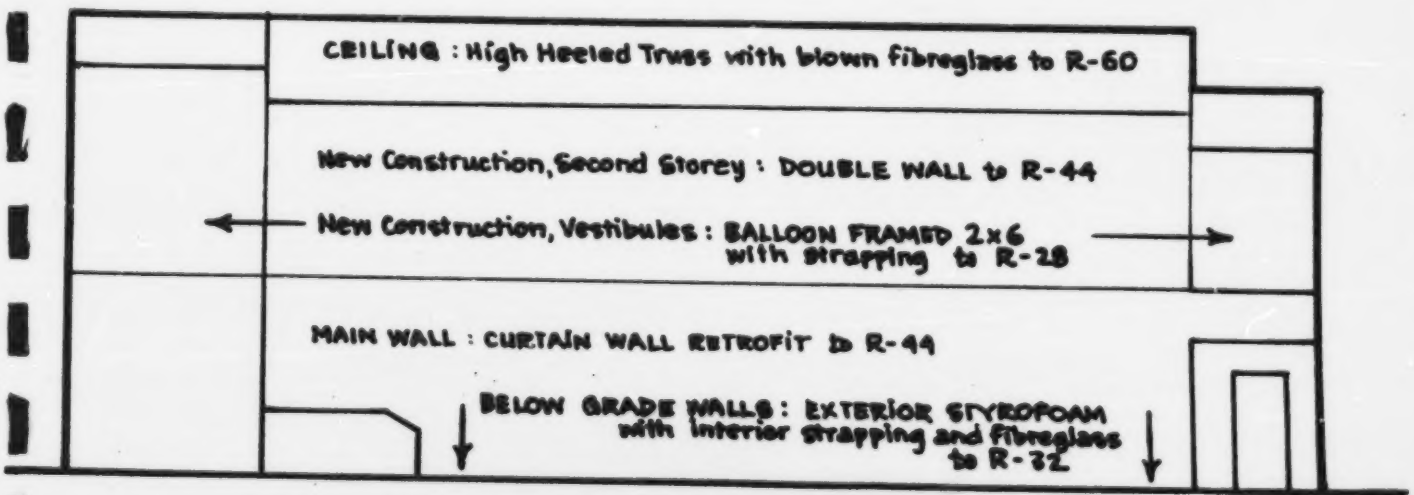
In all three methods of energy conserving wall construction demonstrated on the Skookum Jim building, the polyethylene was placed with two thirds or more of the insulation on the outside of the a-v barrier.

Of all the insulation materials which are suitable for above grade retrofit, fibreglass was the most economical choice for the Skookum Jim retrofit.

The original main walls of the building contained three and a half inches of fibreglass, with an insulating value of R-12. An additional R-32 in the curtain wall increased the thermal resistance of the main walls to R-44. The double wall was constructed with a cavity space for R-44 insulation.

The strapping on the inside of the 2x6 vestibule walls provided space for an additional layer of insulation, increasing the resistance of the walls to R-28. R-60 blown fibreglass was installed in the main ceiling, and the sloped ceiling was insulated with fibreglass batts to R-60.

For the concrete walls of the basement, the retrofit design included exterior styrofoam insulation, and an interior strapwall with an air-vapour barrier and fibreglass insulation. The 2x2 interior studding is primarily for support of the interior gyproc finish; R-8 fibreglass was added to this cavity.


CEILING : High Heeled Truss with blown fibreglass to R-60
New Construction, Second Storey : DOUBLE WALL to R-44
New Construction, Vestibules : BALLOON FRAMED 2x6 with strapping to R-28
MAIN WALL : CURTAIN WALL RETROFIT to R-44
BELOW GRADE WALLS : EXTERIOR STYROFOAM with interior strapping and fibreglass to R-32

Skookum Jim Centre Retrofit Plan
(front elevation)

5.0 The Retrofit Training Program

Several training programs in the field of energy conservation have been delivered in Whitehorse over the past three years. However, the Skookum Jim training program was the first practical skills training available to carpenters at the community level.

The Training Program was developed as a means of training carpenters from remote communities in the techniques of energy conserving construction. Through this program, the retrofit of the Skookum Jim building became a vehicle for transferring these skills to remote communities.

The primary objective was to provide the ten trainees with skills required to design, retrofit, and construct buildings to perform effectively in the northern climate.

Since building design plays a major role in determining the energy demands of any building, design review was an important component of the training program. The trainees were introduced to the concept of reducing heat loss from the building shell by optimizing the surface area to volume ratio, reducing air leakage and adding insulation.

Blueprint reading was emphasized during training sessions to develop skills in interpreting plans. These sessions included training in reading site plans, floor plans, and elevations, and construction details relating to the placement of the air-vapour barrier.

During the training sessions, the crew also gained experience with on-site adjustments which were made to correct the plans.

The retrofit design for the Skookum Jim building introduced the trainees to several wood-frame construction techniques for reducing energy use in buildings. These construction techniques, in combination with theoretical information provided in training sessions, became the basis for a comprehensive training program.

For example, the curtain wall system used to retrofit the main floor walls of the building introduced the trainees to a method of retrofit which is particularly suited to remote community applications.

The double wall used for the walls of the new second storey gave the crew experience with one method of achieving a wide cavity for insulation in new construction.

The vestibules were designed specifically to give the crew experience with installing footings and concrete floors, preserved wood foundations (PWF), and a 2x6 balloon framed "strapwall" construction technique, which allows additional room for insulation. This opportunity to "start from scratch" on the vestibules brought a broader scope of retrofit techniques into the training.

The reasons for maintaining a-v barrier continuity were discussed extensively during training sessions. Techniques and sealing procedures for sealing the a-v barrier were demonstrated. Quality control of a-v barrier continuity was maintained by the instructors throughout the retrofit/renovation project.

Special techniques for sealing difficult areas such as windows, doors, corners, floor joists, and mechanical and electrical penetrations were addressed at length.

With instruction and experience, the trainees developed effective approaches to sealing the a-v barrier in a wide variety of situations.

Physical characteristics, comparative cost and R-values, and other advantages and limitations of different insulation materials were addressed extensively during training sessions.

The crew learned specific techniques for installing above and below grade insulation. For example, fibreglass loses its insulating value as it is compressed, or if voids or air-spaces are left between the batts. The training sessions emphasized the importance of precise cutting and fitting the batts to fill the stud spaces to reduce air-spaces or compression of the insulation.

Installation techniques also included alternating vertical and horizontal layers of fibreglass batts in the walls to reduce the occurance of voids extending from the interior to the exterior of the building.

In conventional construction, a phenomenon called "thermal bridging" occurs through wooden building components such as wall studs and top plates, because the insulating value of the wood is less than that of the insulation around it. A thermal bridge is a direct pathway for energy movement from a higher temperature to a lower temperature.

The trainees gained an understanding of the effects of thermal bridging through building components, and practiced techniques which are used to reduce this effect in retrofit situations.

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

The training program developed for this project was unique and effective in approach and delivery. Much of the success of this project is attributable to the co-operative efforts of the instructors and the trainees to develop suitable methods of information transfer. The program was based on mutual respect, where the role of the instructors was more as "learning facilitators" than as "trainers".

Traditional northern (survival-oriented) learning skills rely heavily upon keen senses of observation and discernment. Training methods were adapted to enhance and develop these observational skills in the context of building science technology, without the emphasis on conventional "proscriptive" methods of information transfer. These modifications in the training approach complemented the learning skills of the trainees.

With the development of a unique cross-cultural delivery style, complex concepts and calculations were transferred without difficulty.

During the nine month program, the crew learned building techniques developed specifically to cope with the extremes of the northern climate. Practical experience was reinforced with instructional sessions to discuss the theories and principles behind these techniques.

Through this training program, the Skookum Jim project has produced a group of highly adaptive resource people in building science and retrofit technology. The experience gained by these skilled resource people can benefit the housing industry in remote northern communities.

6.0 Building Disassembly

6.1 Salvage

Retrofit Construction Rationale

It is economically important to minimize the amount of materials used in any construction project. This is especially important in remote areas, where salvaging and reusing materials plays an important role in helping to reduce material costs.

Lumber is the most obvious material to salvage, but other materials, such as window glass, insulation, siding, trim, or nails, depending upon their condition and the difficulty of salvage, may be used again as well. The amount of labour involved in preparing materials for reuse will determine whether to save the materials or discard them.

Work Plan

Because the Skookies building was in need of structural upgrading, an extensive disassembly process of the existing building was undertaken, leaving only exterior walls on the main floor and bare foundation.

Training

During disassembly, the training program stressed the importance of salvaging materials where possible, for use during reconstruction.

For example, the 2x10 ceiling joists from the original building were carefully removed so that they could be used to strengthen the main floor joists to meet the occupancy standards for the new building. The 2x6 rafters were used for construction of the main floor loadbearing partition walls. Salvaging techniques such as these were emphasized as a method of significantly reducing material costs of such a project.

6.2 Building Materials Degradation

Retrofit Construction Rationale

Careful disassembly of an older building provides the opportunity to observe original construction techniques. In some cases, the techniques applied to Northern construction can lead to premature deterioration of the structure.

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Areas to investigate for possible deterioration include electrical wiring, insulation, vapour barrier details, dry rot (indicating moisture problems), and other material degradation. Examples of degradation or unsafe conditions can be used to illustrate the importance energy conserving construction techniques during the retrofit process.

Work Plan

Extensive disassembly was undertaken during the renovation of the Skookies building. Many interesting examples of inadequate construction practices were discovered during disassembly. The following examples were noted as relatively common occurances in many northern buildings.

Insulation in the walls had become blackened with airborne dirt filtered by the fibreglass as air moved through the insulation in the building shell. This situation occurs when the air-vapour barrier is not adequately sealed, and the insulation is only filtering the outgoing heated air, or the incoming cold air.

Electrical wiring on ceiling fixtures had overheated. The leakage of warm air, heated further as it escaped through fluorescent light fixtures, had melted the wire insulation and the polyethylene around the junction boxes. This condition can be extremely unsafe, and could result in a serious fire in a building.

Moisture accumulation where the plumbing stacks went through the ceiling, walls and floors in bathroom areas had resulted in dry rot. The action of these microbes weakens the structural strength of the lumber.

Training

During training sessions, air and moisture leakage through the building shell were noted as the primary reasons for materials degradation. Conditions of degradation were used as examples of inadequate design and construction techniques which reduce the longevity of buildings.

In addition to the potential structural and fire hazards of such situations, these conditions will also result in excessive energy loss from the building, and unnecessary heating expense for building occupants. These factors were also addressed during training sessions.

Plans and construction techniques for the building were carefully examined and discussed. Adjustments were made to insure that air/moisture leakage would not affect the structural components the new building.

7.0 Retrofit Construction

7.1 Upgrading Main Floor

Retrofit Construction Rationale

Major retrofit work can include structural upgrading of the building to meet new load factors. Structural alterations are incorporated at the design stage, as they can be calculated prior to any work on the building. Additional structural strength may be required for floors, walls, or roof trusses, depending upon the specific details of the retrofit design.

Work Plan

In the Skookies building, it was necessary to provide additional strength in the main floor to meet occupancy related code requirements. The main floors were strengthened by inserting a second 2x10 joist alongside each existing floor joist. The 2x10 lumber was recycled from the original ceiling joists.

Upgrading the basement and main floor load-bearing walls was necessary to meet the structural requirements for the new second storey. This involved installing a six-ply 2x12 beam to span areas where the new main floor walls were not directly above the load-bearing wall in the basement.

Training

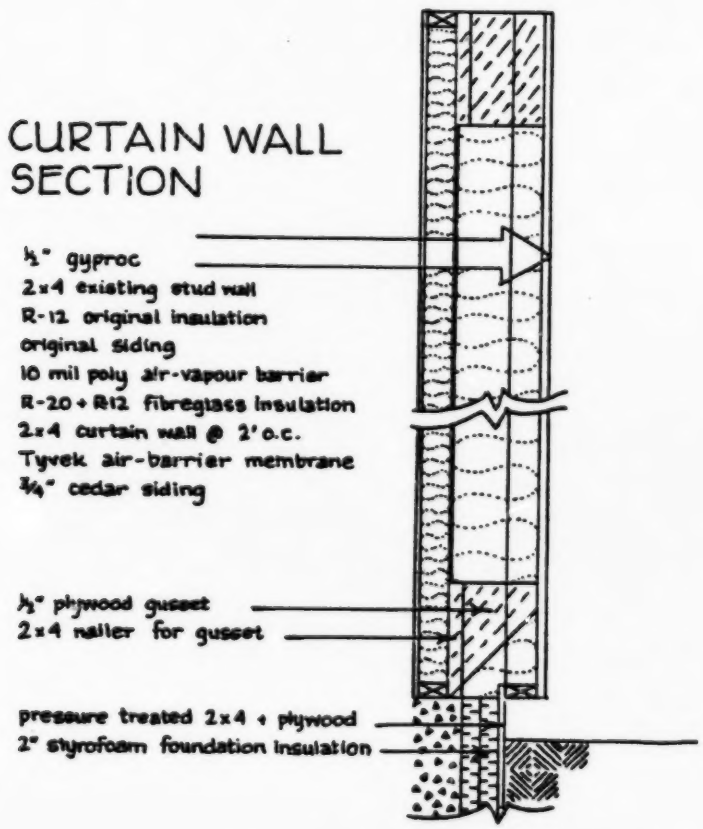
The crew were introduced to the National Building Code Handbook and the use of Load and Span tables for choosing appropriate lumber to meet structural requirements. The crew learned that commercial building occupancy standards required that the new main floor carry a load of 4.8 kiloNewtons per square metre (96 pounds per square foot). These figures apply to areas rated for "assembly" occupancy.

7.2 Main Wall (Curtain Wall)

Retrofit Construction Rationale

Curtain walls are becoming a standard method of expanding the wall cavity to accept a much thicker blanket of insulation. The advantages of the curtain wall include simplicity of design, and the economical use of materials. The curtain wall uses conventional framing techniques without additional structural requirements around window and door openings, as it is not a load-bearing wall.

For retrofit or new construction the non-structural curtain wall consists of vertical 2x4 members secured to the main wall with plywood gussets. The gussets provide extra depth for added insulation. The top of each curtain wall stud is nailed to a roof rafter or a gusset at 2 ft centres. The bottom gusset is secured to the wall, usually at the ring joist; the lower end of each curtain wall stud is secured to this plywood gusset. The bottom of the curtain wall is secured with a plywood bottom plate which acts as an insulation stop. The a-v barrier is hung on the outside of the existing main wall prior to installation of the curtain wall.



SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Work Plan

The main rationale for using the curtain wall retrofit system on the Skookum Jim building is the potential transferability of this method to remote communities. The curtain wall has several advantages over other retrofit systems. These advantages include; low materials requirements, reduced labour requirements, and less disruption to the occupants of the building than other full-wrap retrofit methods. The use of a plywood gusset system for the curtain wall allows the retrofit wall to be hung plumb and true over existing walls which are not.

On the Skookum Jim Building, a curtain wall system with R-32 insulation was added to the outside of the main floor walls. The new wall has a total of R-44, when combined with the R-12 insulation in the existing walls.

Training

The crew were involved in the design and development of the curtain wall system. The feedback provided by the crew significantly influenced the development of this simple, straightforward retrofit system. Emphasis was placed upon the suitability of the curtain wall for thermal upgrading of remote community buildings.

During practical training sessions, the crew developed specific details for securing the curtain wall to the existing wall at window and door openings and around corners.

7.3 Foundation Wall Insulation

Retrofit Construction Rationale

Bare concrete foundation walls provide approximately the same insulating value as a single pane of glass. Because it is a poor insulator, concrete is also a good conductor of heat. In an uninsulated concrete basement, a great deal of heat energy soaks directly through the walls to warm the earth outside. Many northern gardens flourish in the warm soil around the sides of buildings with bare concrete foundations. Without exception, insulating all bare concrete walls in the heated area of a building will result in greater energy savings than adding insulation to frame walls or the ceiling.

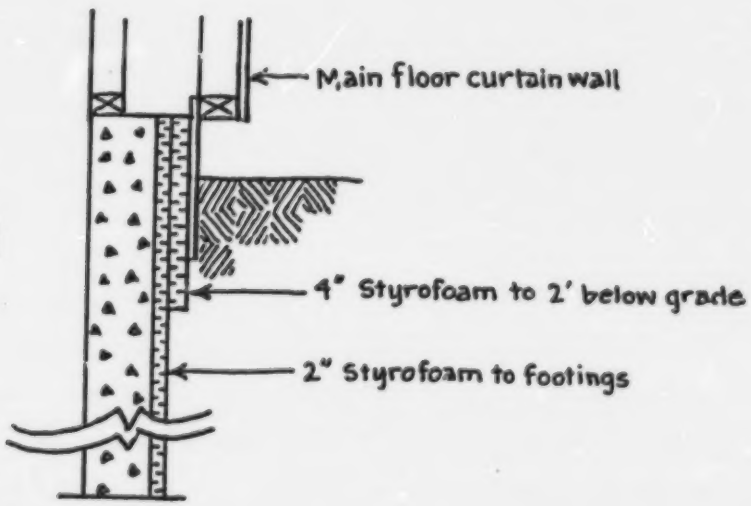
SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

To increase the thermal resistance below grade, basement walls can be insulated on the inside or the outside. However, if insulation is installed on the inside of the wall, the heat will flow across the basement floor and out through the walls into the earth, unless the entire floor of a building is insulated. By insulating the outside of basement walls, this heat path is broken.

Work Plan

The walls of the existing basement were excavated and insulated on the outside to the depth of the footings with R10 polystyrene insulation. An extra layer of R10 insulation was installed along the top two feet of the concrete, where most of the heat loss occurs. PWF plywood was installed around the base of the building below the curtain wall to protect the exposed insulation from damage.

BELOW GRADE INSULATION



Training

During training sessions, the crew learned that bare concrete walls are responsible for excessive heat loss from buildings. Various below grade insulation techniques were compared, and advantages and limitations of each method were discussed. The trainees were introduced to the exterior application of styrofoam as the best method for insulating below grade concrete walls. This method is applicable to any building with a concrete foundation.

8.0 New Construction

8.1 Vestibules

8.1.1 Footings

Retrofit Construction Rationale

Level footings and floors form the base for plumb and level walls. Attention to careful procedures for leveling the forms for the footings before pouring concrete eliminates difficulty in subsequent stages of construction.

There are several devices which provide accurate, reliable leveling. While sophisticated leveling equipment may not always be available in remote communities, devices such as the water level are easy to make from simple, readily available materials.

The water level consists of a long clear hose, filled with water. Any air is purged from the hose by lifting both ends to release trapped air. One end of the hose is then secured to a post at one corner of the forms. The top of the water column is at the same height at either end of the hose; this provides a convenient, movable reference height for leveling concrete forms. By following this procedure at each corner, the forms are easily levelled.

Work Plan

The footings and concrete floors were carefully levelled to provide a stable base for the vestibules.

After the footings were poured, a ten mil polyethylene moisture barrier was placed and covered with wire reinforcing mesh. Concrete was poured and finished for the floors of the vestibules.

Training

The preparation of forms and the placement of concrete footings and floors gave the crew practical experience with measurement, leveling and the need for precision.

The crew was trained in the use of the transit level, as well as other techniques, such as the water level.

8.1.2 Preserved Wood Foundation

Retrofit Construction Rationale

Preserved wood foundations (PWF) offers several advantages for basement construction. PWF is less expensive, and in many cases more suitable than concrete foundations, especially where good concrete and proper mixing facilities are not locally available.

Work Plan

PWF was chosen for the vestibules of the Skookum Jim building to give the crew experience with an alternative to concrete foundation construction.

The 2x6 PWF foundation walls were sheathed with aspenite on the exterior. The polyethylene a-v barrier was installed on the interior of the PWF wall, and secured with horizontal 2x2 strapping.

Training

For the construction of the two vestibules, the crew worked in two teams. This gave the experience of comparing and contrasting the construction of the vestibules. As well, they gained experience in the use of preserved wood foundations as a cost effective alternative to concrete.

8.1.3 Balloon Frame Wall Construction

Retrofit Construction Rationale

In the more common platform framing systems, the height of floors is determined by the height of the walls. "Balloon framing" is an alternative construction method which allows floors to be at any level.

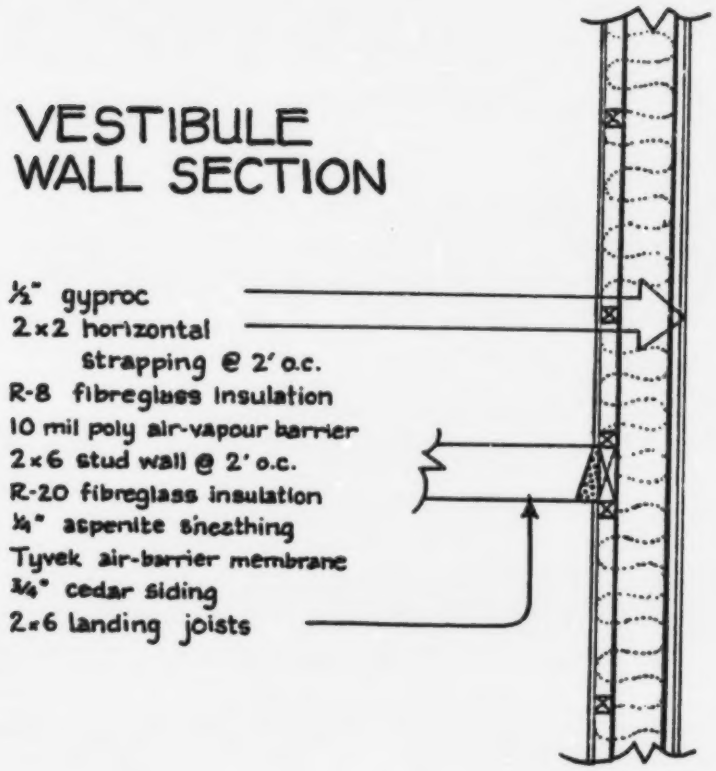
In balloon framing, twelve to sixteen foot high frame walls are built and raised into place. Once the walls are up, a ledge of 2x6 lumber is nailed around the inside of wall to support floors and landings. This framing technique allows a great deal of flexibility in the height of floors, staircases and landings.

An additional benefit is that balloon framing leaves an open interior so that a continuous a-v barrier can be applied to the inside of the walls prior to the installation of the floors. This greatly simplifies the installation of the a-v barrier.

Work Plan

Vestibule walls were "balloon" framed in the Skookum Jim Centre to allow for a more simple staircase and landing design.

The balloon framed walls were constructed with 2x6 on two foot centres. After the air-vapour barrier was in place the walls were strapped on the inside with horizontal 2x2's to allow additional space for insulation, and to protect the A-V barrier from punctures.



Training

The balloon framing gave the trainees experience with hanging landings and staircases. They also gained experience with 2x6 strapwall as a practical method for new residential construction.

The crew evaluated the advantages of balloon framing as a construction method for remote community buildings. This method is ideal for hanging long continuous sheets of polyethylene down the wall without interruption at intermediate floor joists. through this exercise, training sessions introduced the concept of building the exterior frame and applying the air-vapour barrier to the building as if it were one large room. After the shell is completed, the interior walls and floors may be installed to meet the needs of the occupants. This construction approach offers greater flexibility in the design of interior spaces and partitions than conventional platform framing techniques.

8.1.4 Sloped Ceilings

Retrofit Construction Rationale

Sloped ceilings have an advantage over truss roof systems when additional open space is preferable to an enclosed attic. A sloped ceiling may be used to provide additional clearance above low walls, or for a loft in an open plan design.

Work Plan

To provide the required headroom at the top of the staircase in the north vestibule, a sloped ceiling design was chosen. In this case, a flat ceiling would not have allowed adequate space according to the building code. A plywood and lumber beam was used in the north vestibule to create a sloped ceiling with room for R-60 fibreglas insulation. This truss was developed from the plywood and lumber floor beam system used to support the new second storey of the building. These beams are covered in greater detail in the following section 8.2.1.

Training

The trainees used the experience gained in the construction of the plywood and lumber floor beams to lay out and construct the beams for the sloped ceiling in the north vestibule.

Training focused on designing the beam system to meet the necessary structural requirements at the apex.

8.2 Second Storey

8.2.1 Floor Beam System

Retrofit Construction Rationale

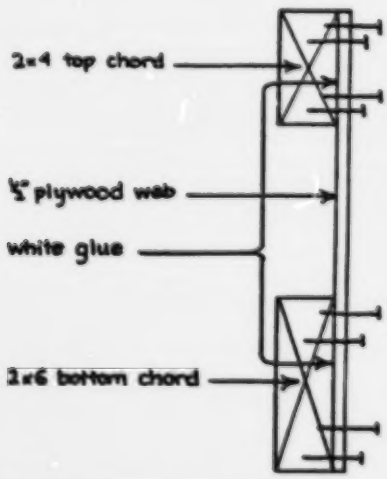
Good quality, long span dimensional lumber joists are becoming increasingly difficult to obtain in many remote communities. Where they are available, the cost is prohibitively high. Plywood and lumber beams can be used as an alternative to conventional solid wood joisting to support the floors.

These beams also offer advantages for the subtrades, such as the electricians, who can run wiring through holes in the plywood webs without having to drill through heavy lumber.

Work Plan

Lumber and plywood beams were chosen for the floor joist system to support the new second storey of the Skookies building. The beams were designed to cantilever over the main wall at the front of the building. The use of lumber and plywood beams to span the distance between support walls was far less costly than using dimensional lumber floor joists to provide the required additional structural support.

Although prefabricated floor trusses can be obtained from the south, it was found that site-built trusses are much more cost-effective. By setting up a pattern or "jig" along the floor, a team of two could build three beams in a day. This method is labour intensive, however, it maximizes the use of local resources.



PLYWOOD + LUMBER FLOOR BEAMS

Each beam consisted of a 2x4 top chord and a 2x6 bottom chord, which form the top and bottom edges of the beam. A continuous plywood web along one side of the chords provided the necessary depth to meet the strength for the span required. To provide additional strength, the plywood webs were glued to the top and bottom chords, prior to nailing. A detailed nailing pattern was used to insure that the structural requirements for the beams were met.

Training

Since the beams for the Skookum Jim building were fabricated on site, efficiency of production was an important factor. During beam construction, the crew learned several important approaches to maximizing efficiency in an "assembly line" production situation.

To develop skills in reading and interpreting specifications and code, the crew was trained in the use of Lumber and Plywood Beam Design tables to calculate the design loads and dimensions for the beams.

The main floor of the Skookum Jim building became the assembly area for the plywood and lumber beams. Here, the materials could be laid out and assembled without interfering with other work on the building. Small crews took turns at floor beam construction so that each trainee had the opportunity to assemble several beams from start to finish.

Techniques used to increase production efficiency included the use of a floor jig, which consisted of 2x4 blocking nailed to the floor to mark the precise location of each beam component. Another method which the training incorporated involved precutting all the beam components. This considerably reduces the time involved in assembly, as compared to custom-cutting components for individual beams.

The nailing pattern and the size of nails used, and the layer of glue between the plywood web and each chord are crucial to the strength of the beams. The crew learned that using smaller nails in a tight geometric pattern is the most effective way to distribute the forces of the building. The additional strength gained by the application of glue between each chord and the plywood webs was demonstrated during training sessions. The nails and glue securely integrate the top chord, the web, and the bottom chord so that the loads in the building are equally distributed without distortion.

Training sessions emphasized quality of workmanship throughout the beam fabrication process.

8.2.2 Double Wall

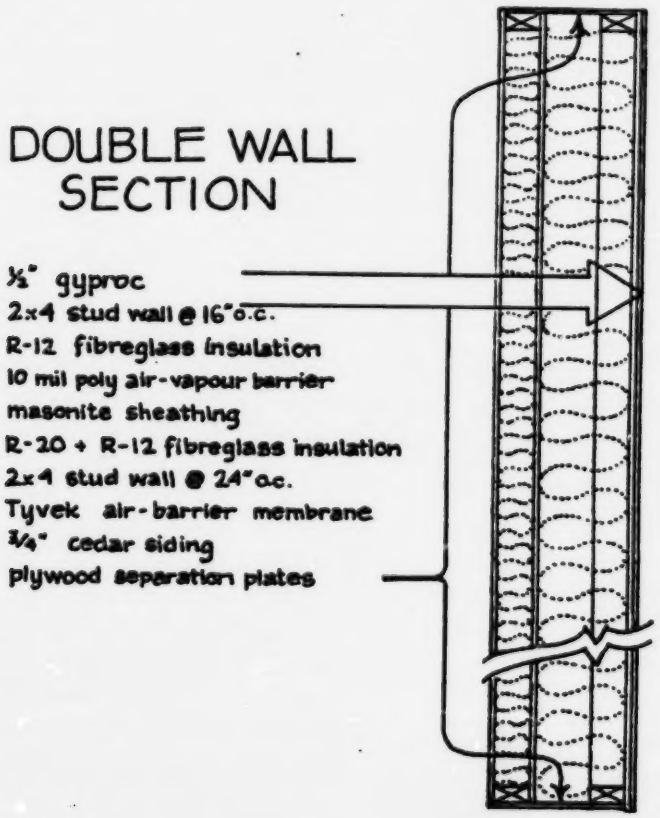
Retrofit Construction Rationale

The double stud wall method of construction was developed in Saskatchewan as a method of increasing the wall cavity to allow space for more insulation.

A standard, platform framed stud wall with window and door openings is constructed on the floor so that the bottom of the wall is positioned close to the edge where it will be erected. This wall is covered with a continuous sheet of polyethylene, which is then covered by masonite or another protective sheathing. Window and door openings are precut in the masonite before laying it down over the a-v barrier.

A second wall, (non-structural 2x4) is then built directly on top of the masonite. Window and door openings must precisely match those in the first wall.

The second wall is lifted and blocked with short scraps of 2x6 to achieve a uniform separation. Plywood top and bottom plates are then secured to the walls to hold them apart. The entire assembly is raised into place as one unit.



SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Work Plan

The Skookum Jim Centre features "double stud wall" construction for the two long walls of the second storey. The walls are separated to allow space for R-44 insulation.

Training

The double stud wall was chosen to give the crew experience with a high R-value energy conserving wall used mainly for new construction. During the training sessions, the instructors and the crew compared labour and materials costs for the double wall, the curtain wall, and 2x6 strapwall techniques. They noted that the retrofit portion of the double wall method is more labour intensive and uses considerably more materials than other retrofit methods.

8.2.3 Roof Trusses

Retrofit Construction Rationale

One problem with conventional roof trusses is the low clearance at the outside edges of the truss which cannot accommodate the same amount of insulation as the rest of the ceiling. Energy conserving construction employs the use of "high-heeled" trusses to allow the full depth of insulation to extend all the way to the outside edges of the wall.

Work Plan

High-heeled roof trusses for the Skookum Jim building were fabricated by a local truss manufacturer, and lifted onto the building with a crane. Such trusses may be site-built from design drawings, however, in this case, it was more expedient to have them built to specifications locally. Ten mil polyethylene was attached to the bottom chords of the trusses and held in place with 1x4 strapping. This ceiling a-v barrier was sealed to the polyethylene in the walls to form a continuous a-v barrier. The roof was insulated to R-60 with blown fibreglass.

Training

The crew visited the truss factory to view the operation and to discuss truss layout and construction. During this visit, the crew observed methods and materials used in the truss fabrication process. This is useful for duplicating the procedure in remote communities, using locally available resources, materials, and labour wherever possible.

9.0 Windows and Doors

Retrofit Construction Rationale

Windows and doors are often responsible for much heat loss due to air-leakage around the openings, and between the frame and the wall. Therefore, it is important for the construction industry to be familiar with the qualities and limitations of different door and window designs, as well as effective installation techniques.

During a retrofit, window openings and doorways may require relocation and strengthening to meet design specifications or to accommodate additional solar gain.

Work Plan

All of the original window and door openings on the main walls in the Skookum Jim building were relocated for the new building. New triple pane windows were used throughout the building. Doors were fitted with specifically selected weatherstripping suitable for northern climate conditions.

Training

The crew gained experience with relocation of window and door openings. During training sessions, instruction focused on techniques for achieving a-v barrier continuity around windows and doors. This included methods of cutting and folding the wall a-v barrier around the inside of the rough opening, and installing a strip of poly around the window or door frame itself. The edges of the poly were overlapped and sealed with acoustical sealant after the window was installed.

10.0 Exterior Finish

Retrofit Construction Rationale

If cold air (wind) is allowed to blow through the thickly insulated wall cavity, the insulation qualities of the fibreglass will be decreased. Plywood is often used as an exterior sheathing to block air travel and to provide additional strength. Exterior sheathing is not required for curtain wall or double stud wall since the exterior studs are not load-bearing. Tyvek is a light-weight moisture permeable air-barrier membrane made of spun polyethylene. Tyvek can be used in place of exterior sheathing, then covered with the finish siding.

Work Plan

All of the walls in the Skookum Jim building were sheathed with a layer of Tyvek to protect the insulation. Cedar siding and shakes were used to finish the exterior of the Skookum Jim building.

Training

The crew gained experience with the characteristics and applicability of Tyvek air-barrier membrane as an alternative to plywood sheathing and building paper. Tyvek is less expensive than plywood, and much lighter (therefore less costly) to transport to remote communities.

Another advantage the crew discovered is that Tyvek is much easier to install than plywood and building paper, as it is applied in wide rolls around the building.

11.0 Economics of Retrofit

The economic factors affecting energy conserving retrofit work are unique in remote communities. In many cases, particularly in the north, the building stock is not thermally sound, with air leakage and inadequate insulation levels contributing significantly to expensive, ongoing building maintenance problems. In combination with inefficient heating systems, this results in great operating expense to building owners and occupants.

These factors, combined with the high cost of materials, makes retrofitting existing buildings an economically attractive alternative to new construction. Many remote communities are presently undertaking extensive retrofit work on housing and community buildings to solve annual maintenance problems and to extend the useful lifetime of the building.

11.1 Economics of the Skookum Jim Retrofit Project

At the time of the Skookum Jim retrofit project, costs for conventional light-commercial construction in Whitehorse were approximately $72 per square foot of floor area. This estimate does not include high insulation levels or specific attention to air-vapour barrier continuity.

The completed Skookum Jim Building cost $66 per square foot of finished floor area. This cost includes the retrofit training program, labour costs for the trainees, additional energy conserving features in the building (R-44 walls, R-60 ceiling, R-20 below grade), the heating (and heat recovery) system, and interior finishing and furnishing.

11.2 Post-Retrofit Operating Cost

The original heating system consisted of an oil-fired furnace. Fuel oil costs for the 1982/83 heating season were $7800, and electrical costs, including lights and equipment, were $2800. Total energy costs for the building amounted to $10,600.

The retrofit/renovation project included 60% increase in the heated area of the building.

The heating system in the new building consists of four electric heaters, with a total capacity of 24 kW (82,000 BTU/hr). Heat recovery is provided by an air-to-air heat exchanger.

In observing the operation of the new building during the first heating season, it was noted that the heat provided by the lighting in the building supplied the majority of space heating requirements. Back-up electrical heating was required only at temperatures approaching design temperature for the building.

During the first winter of operation (1984/85), total energy costs for the building were approximately $5000. This is less than half the energy cost for the original building during the previous heating season.

12.0 Project Summary

It can be concluded that the Skookum Jim Retrofit Training Project has been a significant success, both in terms of northern training programs, and cost-effective northern retrofit construction.

It is recommended that this program be expanded to include other northern communities. One scenario would involve an instructor and one of the experienced trainees providing retrofit training workshops in a number of remote northern communities during the coming construction seasons. This and other opportunities should be further explored.

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Acknowledgements

Special acknowledgement is extended to the following organizations and individuals who contributed to many aspects of the training and retrofit/renovation. Without their support and encouragement, this demonstration project would not have been possible.

Training program funding: Yukon/Canada Conservation and Renewable Energy Demonstration Agreement (CREDA)

Capital costs funding: Secretary of State, Canada, Native Directorate, New Friendship Centre Program

Participation of Trainees: Canada Employment and Immigration (CEIC)

Development and Delivery of the Training Program: Arctech Community Energy Research Associates

and: Don Henry and the "Skookies" crew, and all the staff and patrons of the Skookum Jim Friendship Centre, Whitehorse, Yukon

APPENDIX A:

RETROFIT TRAINING CURRICULUM OUTLINE

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Curriculum Outline

Skookum Jim Friendship Centre

Retrofit/Renovation Project

Site Safety

Tools (Use and Maintenance)

- Hand tools
- Small power tools
- Stationary power tools

Building Materials

Blueprint Reading

- Site plans
- Floor plans and elevations
- Construction details and specifications
- Retrofit details and specifications

Site Preparation

- Site plan and orientation
- Layout, excavation, and berming

Footings and Foundations

- Base preparation
- Excavation cosiderations
- Footing layout, levelling, and forming
- Foundation types and construction techniques
- Retrofit insulation

Concrete

- Forming
- Reinforcing
- Pouring
- Finishing
- Insulation
- Thermal mass and storage, sizing and location

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Flooring Systems

- Joist planning
- Layout
- Blocking
- Sheathing
- Air-vapour barrier considerations
- Cantilevers
- Design considerations

Framing

- Blueprint review
- Standard framing
- Double wall construction
- Stud layout
- Interior partitions
- Truss sytems
- Air-vapour barrier considerations
- Window and door openings

Retrofit Framing

- Existing structure modifications
- Secondary wall layout
- Curtain wall design and layout
- Air-vapour barrier installation
- Vestibules
- Overhang considerations
- Half-wrap vs. full wrap
- Vents and chimneys
- Partition walls
- Interior vs. exterior retrofit

Roofing

- Truss systems
- Sheathing
- Shingling and other roofing surfaces
- Finishing
- Roof:wall joint techniques
- Air-vapour barrier continuity
- Sloped ceilings
- Ventilation requirements
- Roofing color

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Doors and Windows

- Preparation of rough openings
- Air-vapour barrier continuity
- Selection of door and window hardware
- Preparation and installation
- Problems with existing doors and windows
- Retrofit considerations
- Window insulation

Exterior Finish

- Siding application
- Surface finishing
- Detail finishing
- Anomolies in exterior finish for diagnosis of problems
- Energy - heat loss considerations
- Color

Insulating

- Types of insulation
- R, Rsi factors
- Advantages and disadvantages of different materials
- Cost considerations
- Wall insulation techniques
- Ceiling insulation and ventilation
- Below grade insulation: interior vs. exterior
- Floor insulation
- Retrofit situations (old insulation materials)

Air-vapour Barriers

- Windows and doors
- Floor and ceiling
- Electrical outlets
- Mechanical penetrations
- Corners and overlap
- Floor joist variations

SKOOKUM JIM FRIENDSHIP CENTRE RETROFIT/RENOVATION

Interior Finishing

- Drywalling and panelling
- Overlay flooring
- Interior doors
- Door and window casings
- Baseboards
- Basic cabinet making
- Flooring
- Basic Surface finishing
- Weathersealing and air leak sealing

Basic Stairs Construction

- Site measurements
- Wood selection
- Stair layout
- Stringer and stair construction
- Handrails
- Finishing and surfacing

Environmental Quality

- Air quality considerations
- Vapour considerations
- Living in energy efficient homes
- Air to air heat exchangers

Estimation

- Materials takeoffs
- Sub-trades estimates
- Overall Construction estimates
- Construction phasing

Energy, Mines and Resources Canada | Énergie, Mines et Ressources Canada

Yukon
Department of Economic Development and Tourism

SKOOKUM JIM FRIENDSHIP CENTRE

Final Project Summary

Canada/Yukon Conservation and Renewable Energy Demonstration Program

Project No.
3766-4-27

Date:
August, 1984

Sectors:
All Sectors

Project Locations:
Whitehorse

Technology:
Conservation Training

Jurisdiction:
Yukon

Project Manager:
Stan Boychuk

Status:
Complete

Purpose:

1. To perform a complete retrofit on a 25 year old community/social services building.
2. To use the retrofit as a vehicle for training carpenters.
3. To develop a network of community energy specialists in Yukon.
4. To produce audio-visual and printed resources for public use on energy efficient construction and retrofit techniques.

Description:

Individuals from native communities throughout the Yukon were selected to represent their Bands and participate in a six-month training program. The focus of the study was on all aspects of energy conservation construction from exterior retrofits to new home energy design and construction.

Contributors:

Skookum Jim Friendship Centre	$ 31,952
G.I.T.	34,812
C.E.I.C.	88,126
E.C.I.P.	10,000
Secretary of State	229,000
CREDA	74,110
TOTAL	$468,000

Demonstrated Benefits:

Creation of a network of community energy specialists who are able to assist in the implementation of energy conserving projects.

Further Information:

Stan Boychuk, Skookum Jim Friendship Centre, 3159 3rd Avenue, Whitehorse.
(403) 667-4465.

Economic Analysis:

In this project it is not possible to perform a definite economic analysis because of the nature of the project. The Skookum Jim Training project will have a dramatic effect on energy conservation and housing standards in remote communities in the years to come. It is, however, possible to perform an economic analysis on the retrofitted building which was used as the training vehicle.

Pre-retrofit fuel consumption:	$\$21.95/m^2$
Post-retrofit fuel consumption:	$\$ 1.67/m^2$
Fuel Savings:	$\$20.28/m^2$
Annual Savings:	$10,900
Cost of renovation and retrofit:	$358,900
Simple payback:	32.9 years

This analysis represents a calculation of simple payback on the renovation and the retrofit from energy savings. It is not possible to isolate the costs of the retrofit itself. The analysis cannot place an economic value on the renovated building even though it has twice the floor space and is much more useful than the old building.

Technical Details:

Heat for the new Skookum Jim Friendship Centre is provided by four small electric forced air heaters. At design temperature (-43 degrees Celcius) the building will require 28 kW/hr. Above -15 degrees C. the building can be heated solely from the waste heat generated from 14 kW of incandescent lighting, and from the occupants.

Two air-to-air heat exchangers providing ventilation operate at an average of 80 per cent efficiency.

Information Transfer:

A video and manual on the training program have been prepared and are available from:

David Arseneault
Information Officer, Energy Branch
Department of Economic Development
and Tourism
Government of Yukon
P.O. Box 2703, Whitehorse, Y1A 2C6
(403) 667-5384